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(54) CONDUCTIVE COMPOSITION, CONDUCTOR AND ITS FORMATION METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a conductive composition exerting high conductivity with excellent film forming capability, moldability and colorless transparentness without temperature dependency, to provide a conductor capable of forming and providing a conductive film exerting high conductivity, having little dispersion of surface resistance with excellent film formability, moldability and colorless transparentness without humidity dependency and to provide its formation method.

SOLUTION: This conductive composition contains an indole derivative trimer A and a solvent B, and if required, a basic compound C, a surface active agent E and/or an inorganic salt F. This conductor is formed of the conductive composition. This formation method is used for forming the conductor.

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CLAIMS

[Claim(s)]

[Claim 1]An indole-derivatives trimer (A) and a conductive composition containing a solvent (B).

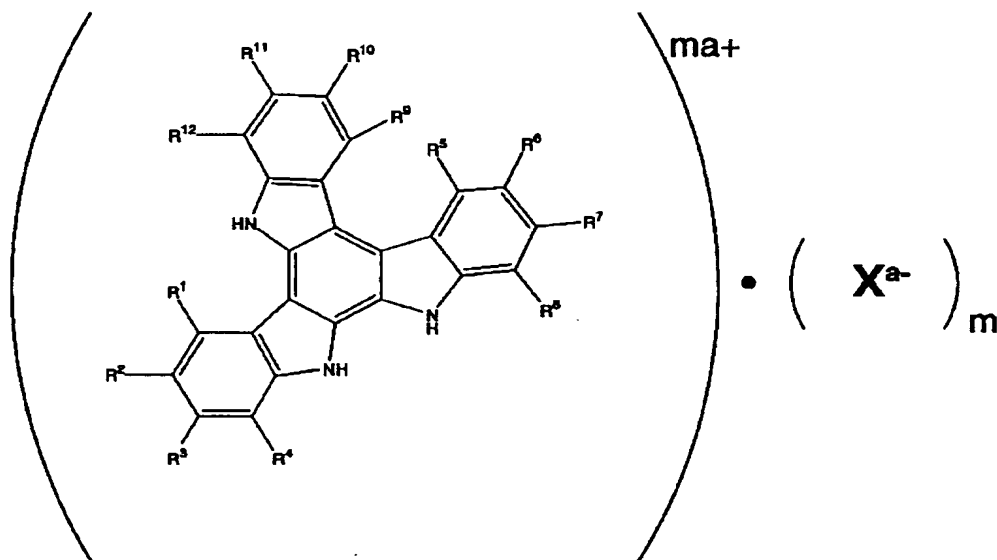
[Claim 2]The conductive composition according to claim 1, wherein a conductive composition contains a basic compound (C).

[Claim 3]The conductive composition according to claim 1 or 2, wherein a conductive composition contains a high molecular compound (D).

[Claim 4]A conductive composition given in any 1 paragraph of claims 1-3, wherein a conductive composition contains a surface-active agent (E).

[Claim 5]A conductive composition given in any 1 paragraph of claims 1-4, wherein a conductive composition includes mineral salt (F).

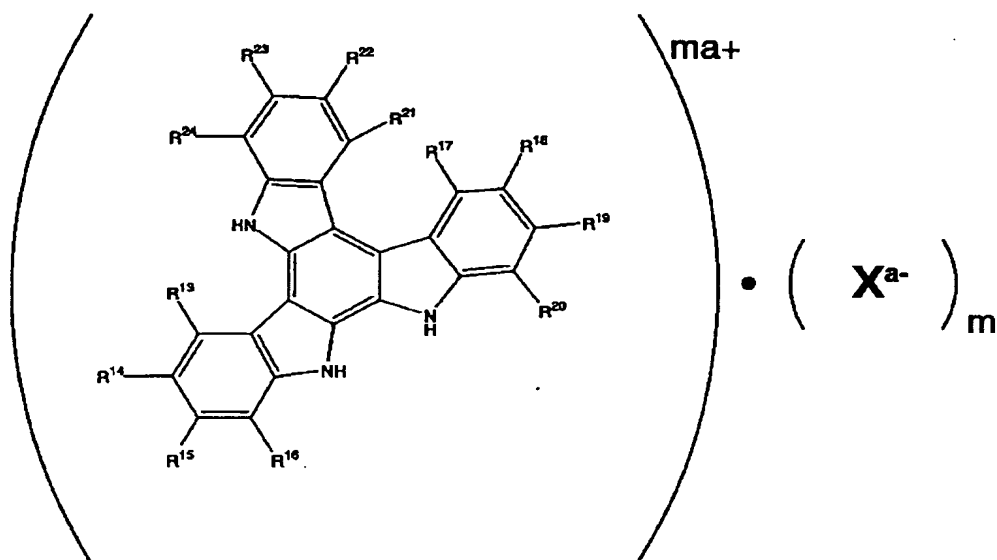
[Claim 6]An indole-derivatives trimer (A), [Formula 1]



(1) (R¹ - R¹² among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxylic acid group, It is the substituent independently chosen from the group which consists of the straight chain of the carbon numbers 2-24, the straight chain of the carboxylate group of branching, a sulfonic group, and the carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively. X^{a-} A chloride ion, a

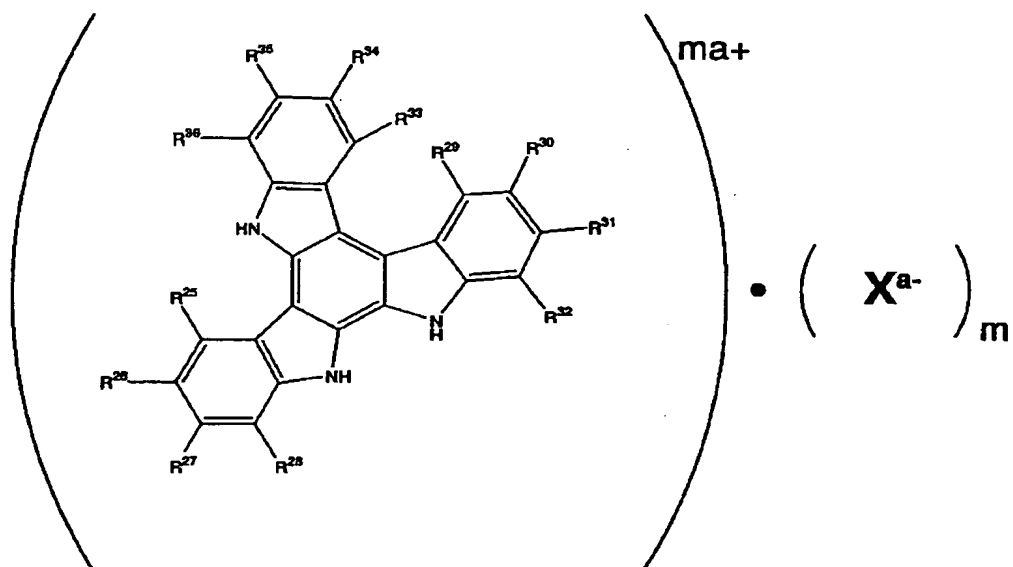
bromine ion, iodine ion, A fluorine ion, nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, Way fluoridation ion, a perchlorate ion, thiocyanic acid ion, acetate ion, Propionic acid ion, methanesulfonic acid ion, p-toluenesulfonic-acid ion, They are at least one sort of negative ion chosen from 1 which consists of trifluoro acetate ion and trifluoromethanesulfonic acid ion - a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1-3, m is a dope rate, and the value is 0-0.5. Conductive composition given in any 1 paragraph of some claims 1-5.

[Claim 7]An indole-derivatives trimer (A), [Formula 2]

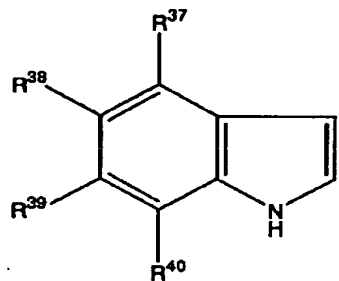


(2) $R^{13} - R^{24}$ among the above-mentioned formula, The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2-24 or the carboxylate group of branching, a sulfonic group, The straight chain of the carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, It is shown by the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of $R^{13} - R^{24}$ is the basis chosen from the cyano group, the nitro group, the amide group, or the halogen group. X^{a-} A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, And it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion - a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1-3, m is a dope rate, and the value is 0-0.5. Conductive composition given in any 1 paragraph of some claims 1-6.

[Claim 8]An indole-derivatives trimer (A), [Formula 3]



(3) ($R^{25} - R^{36}$ among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2-24 or the carboxylate group of branching, a sulfonic group, The straight chain of the carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, It is shown by the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of $R^{25} - R^{36}$ is a sulfonic group or a carboxyl group. X^{a-} A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, And it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion - a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1-3, m is a dope rate, and the value is 0-0.5. Conductive composition given in any 1 paragraph of some claims 1-7. [Claim 9]An indole-derivatives trimer (A). [Formula 4]



(4) ($R^{37} - R^{40}$ among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2-24 or the carboxylate group of branching, a sulfonic group, The straight chain of the

carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, It is the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively. At least a kind of indole derivatives shown, A conductive composition given in any 1 paragraph of claims 1-8 characterized by being the indole-derivatives trimer obtained by making it react with a kind of oxidizer into the reaction mixture containing at least a kind of solvent at least.

[Claim 10]A conductive composition given in any 1 paragraph of claims 1-9, wherein an indole-derivatives trimer (A) is a laminated structure.

[Claim 11]A conductor having a transparent conductive film formed in any 1 paragraph of claims 1-10 from a conductive composition of a statement.

[Claim 12]The conductor according to claim 11, wherein acid has added to a transparent conductive film as a dopant.

[Claim 13]A formation method of a conductor characterized by performing neglect or heat-treatment at ordinary temperature after applying a conductive composition of a statement to any 1 paragraph of claims 1-10 and forming a transparent conductive film on at least one field of a substrate.

[Claim 14]A formation method of the conductor according to claim 13 performing doping processing by acid and performing neglect or heat-treatment at ordinary temperature subsequently after forming a transparent conductive film.

[Claim 15]A formation method of the conductor according to claim 13 or 14 heat-treating from ordinary temperature in a 250 ** temperature requirement.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to a conductor formed from the conductive composition containing an indole-derivatives trimer, and this conductive composition, and a formation method for the same. The conductive composition of this invention by using simple techniques, such as spreading, a spray, the cast, and dip, various sprays for preventing static electricity, It is applicable to uses, such as a capacitor, a cell, EMI shielding, a chemical sensor, a display device, nonlinear material, an anticorrosive, adhesives, textiles, an antistatic coating, an anticorrosive paint, an electrodeposition paint, a plating primer, an electrically conductive primer for electrostatic coating, electric anticorrosion, and accumulation-of-electricity ability improvement of a cell. The conductor of this invention Industrial use wrapping, such as a semiconductor and electrical machinery electronic parts, Antistatic films, such as electro photography recording materials, such as a film for overhead projectors, and a slide film, The prevention from electrification of tapes for magnetic recording, such as an audiotape, videotape, a tape for computers, and a floppy disk, The input of a transparent touch panel, an electroluminescence display, a liquid crystal display, etc., and the prevention from electrification and the transparent electrode on the surface of a display device, It is used as the luminescent material which forms an organic

electroluminescence element, buffer material, an electron transport material, a hole transporting material, and a fluorescent material.

[0002]

[Description of the Prior Art]Conventionally, as an electric conduction ingredient of a conductive composition, conductive polymers, such as organic system conducting agents, such as inorganic system conducting agents, such as metal system powder, carbon powder, and ITO, and a surface-active agent, and poly aniline, and sulfonation poly aniline, are known.

[0003]although the conducting film formed from the conductive composition which consists of carbon powder, metal powder, and a high molecular compound in these is excellent in the endurance of a coat — the addition of an electric conduction ingredient — ten mass part – about 30 mass parts are needed and there is a fault that transparency is missing. In order to make transparency reveal, when the addition of an electric conduction ingredient is reduced, sufficient conducting performance has a fault which is not acquired. What gave hydrophilic nature and ionicity and gave conductivity to the film surface is known by scouring a surface-active agent with translucent anionic system, cation system, non-ion system, both sexes, etc., etc. in a plastic film, or on the other hand, coating the plastic film surface with them. However, for ion conductivity, that conductivity tends to be influenced by the humidity in the atmosphere, and the conducting film obtained by this method has the fault that the surface resistance value per unit area cannot obtain conductivity below 10^{-9} ohm stably on condition of low humidity.

[0004]It is known that the conductor produced by vapor-depositing ITO (indium tin oxidation thing) as an electric conduction ingredient is excellent in transparency and conductivity. However, since a vacuum evaporator is necessity in order to make the thin film form, creation of a conducting film is complicated, and the device is expensive. And since ITO used as a material is also expensive, the conductor obtained also has the fault of becoming expensive.

[0005]Although the conductive polymer which doped poly aniline etc. is known well, there is a fault that it is insoluble to almost all solvents, and shaping and processing are difficult. Although the method (JP,60-235831,A, J.Polymer Sci., Polymer Chem.Ed., and [26, 1531] (1988)) of carrying out electrolytic oxidation polymerization of the aniline can form the film of poly aniline on an electrode, There is a fault that isolation operation's becoming complicated and extensive composition are difficult. Although the conductive composition (JP,3-285983,A) in which poly aniline and acid dissociation constant electric dissociation exponent of a dedope state acquired by the chemical oxidation polymerization of aniline consist of ammonium salt of the proton acid which is 4.8 or less on the other hand is reported, It is hard to say that poly aniline of a dedope state has a fault, such as affecting it, in a coating substrate, and is suitable for it as a general-purpose varnish since it is meltable only to the very strong special solvent of solvent power, such as N-methyl-2-pyrrolidone. The coat obtained from this constituent has coloring of green peculiar to a conductive polymer – blue.

Since the color tone of a substrate and the color tone of the coating material of glazing are affected, the technical problem of an application use being restricted occurs.

[0006]In order to solve the technical problem to the solubility of a conductive polymer, the conductive composition using the conductive polymer (sulfonation poly aniline) which has acidic groups, such as a sulfonic group, in poly aniline is proposed (the patent No. 03051308, JP,8-143662,A). It is usable in water as

a solvent, this constituent does not have humidity dependency, high conductivity is revealed, and forming the conductor excellent in membrane formation nature, a moldability, and transparency is reported. However, since it is colored yellow and the color tone of a substrate and the color tone of the coating material of glazing are affected by sulfonation poly aniline also about the color tone of the coat obtained from this constituent, the technical problem of an application use being restricted occurs.

[0007]On the other hand, the method of compounding the Indore trimer which is not replaced [which has conductivity by an electrolysis reaction by using Indore as a raw material] is reported by [Synthetic Metals and 80 (1996) 309 page]. However, in this report, there is no example used as a conductive composition which made the non-substituted indole trimer only form on an electrode, and dissolved in the solvent, and since it is an electrode reaction, it also has the fault that the shape and construction material of a substrate will be limited.

[0008]The indole- 5-carbonitrile which is indole derivatives, Although forming an indole-derivatives trimer on an electrode by the method [Phys.Chem.Chem.Phys., 2, 1241-1248 (2000)] of carrying out electrolytic oxidation polymerization of the indole- 5-carboxylic acid into acetonitrile is reported, Since this is also an electrolysis reaction, it has the fault that the shape and construction material of a substrate will be limited.

[0009]

[Problem(s) to be Solved by the Invention]It is made in order that this invention may solve the problem of everything of the above-mentioned conventional technology, The conductive composition which it is temperature-independent, revealed high conductivity, and was excellent in membrane formation nature, a moldability, and water-white nature, And there is no humidity dependency using this constituent, high conductivity is revealed, dispersion in surface resistance is small, and it is in providing a conductor produced by making form the conductive film excellent in membrane formation nature, a moldability, and water-white nature, and a formation method for the same.

[0010]

[Means for Solving the Problem]In order to solve these technical problems, as a result of inquiring wholeheartedly, this invention persons found out that a constituent containing a trimer of indole derivatives fitted this purpose, and reached this invention. That is, the 1st of this invention is a conductive composition containing an indole-derivatives trimer (A) and a solvent (B). This conductive composition can aim at improvement in performance by including further a basic compound (C), a high molecular compound (D), a surface-active agent (E), and/or mineral salt (F). High performance is shown that this indole-derivatives trimer is a layer system which is 0.1-0.6 nm of interlayer spacings.

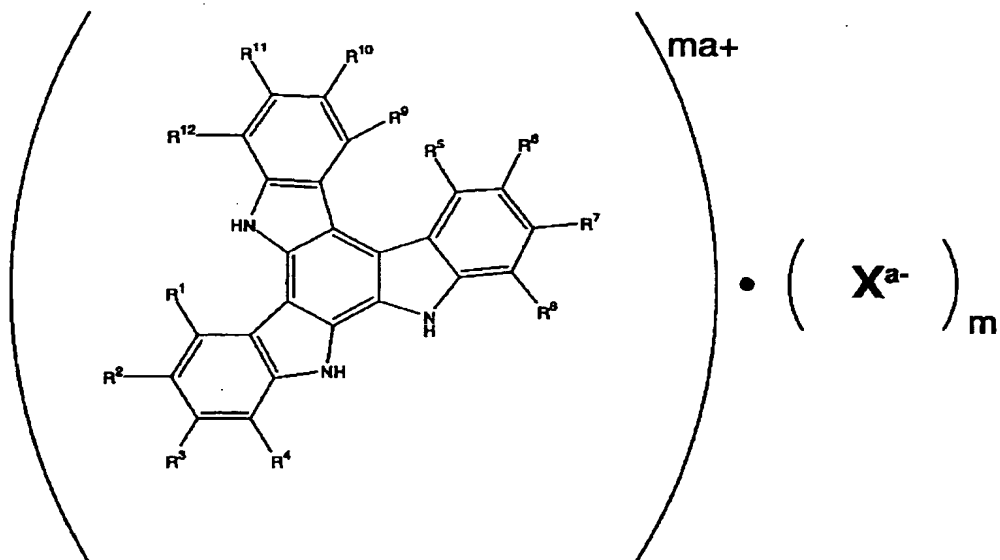
[0011]The 2nd of this invention is a conductor having a transparent conductive film formed from this conductive composition. Improvement in performance can be further aimed at because acid has added to this transparency conductive film as a dopant.

[0012]It is a formation method of a conductor performing neglect or heat-treatment at ordinary temperature after applying this conductive composition and forming a transparent conductive film on at least one field of the 3rd substrate of this invention.

[0013]

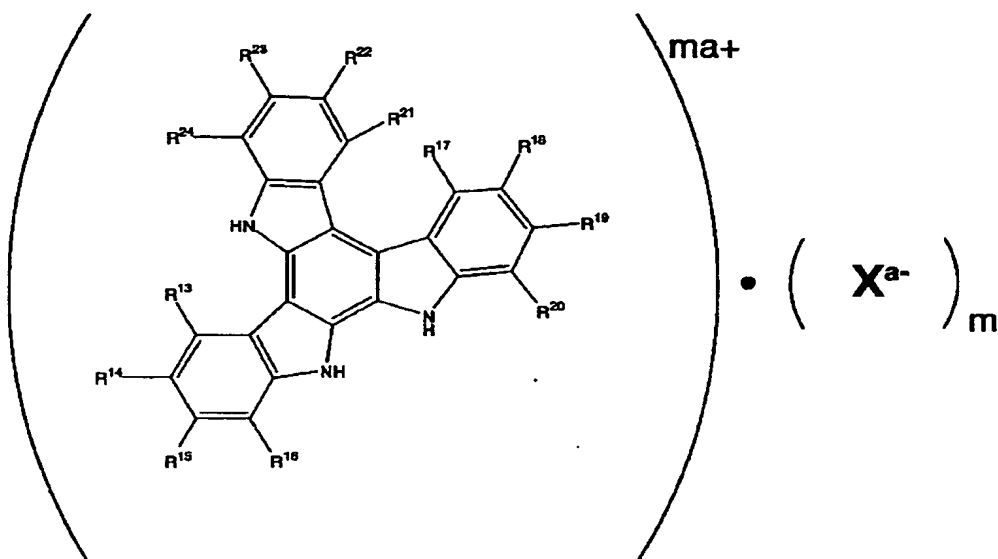
[Embodiment of the Invention]Hereafter, the conductor formed from the conductive composition and this conductive composition of this invention and its formation method are explained in detail.

[0014] As a constituting-conductive composition and conductor of this invention indole-derivatives trimer (A), [Formula 5]



(1) (R¹ – R¹² among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1–24, the alkyl group of branching and the straight chain of the carbon numbers 1–24, or the alkoxy group of branching, The straight chain of the carbon numbers 2–24 or the acyl group of branching, an aldehyde group, a carboxyl group, It is the substituent independently chosen from the group which consists of the straight chain of the carbon numbers 2–24, the straight chain of the carboxylate group of branching, a sulfonic group, and the carbon numbers 1–24 or the sulfonic ester group of branching, a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively. X^{a-} A chloride ion, a bromine ion, iodine ion, A fluorine ion, nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, Way fluoridation ion, a perchlorate ion, thiocyanic acid ion, acetate ion, Propionic acid ion, methanesulfonic acid ion, p-toluenesulfonic-acid ion, It is at least a kind of negative ion chosen from 1 which consists of trifluoro acetate ion and trifluoromethanesulfonic acid ion – a trivalent negative ion group, and a expresses the ionic valence of X, it is an integer of 1–3, m is a dope rate, and the value is 0–0.5. It is illustrated.

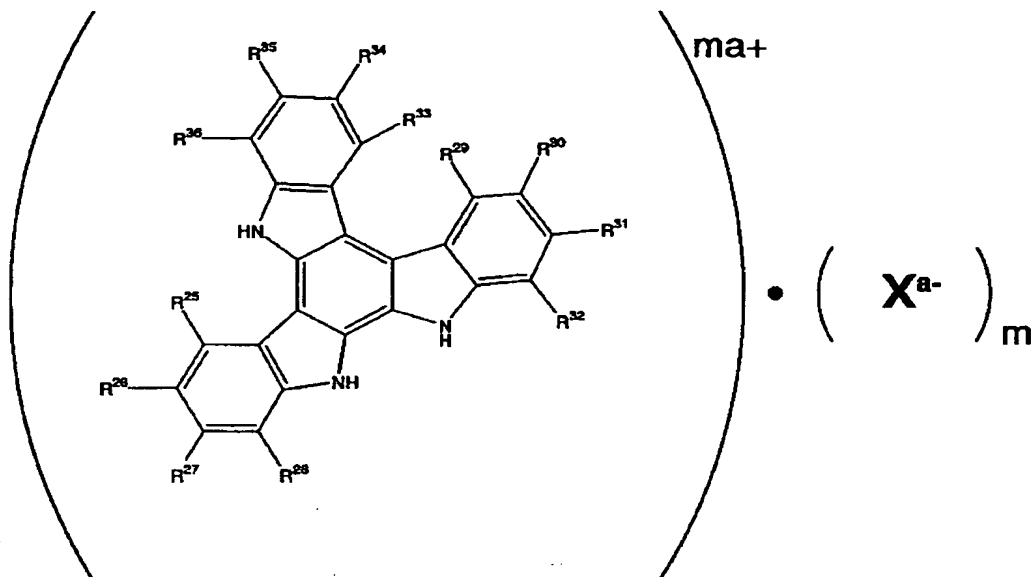
[0015] It is desirable, [Formula 6]



(2) ($R^{13} - R^{24}$ among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2-24 or the carboxylate group of branching, a sulfonic group, The straight chain of the carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, It is shown by the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of $R^{13} - R^{24}$ is the basis chosen from the cyano group, the nitro group, the amide group, or the halogen group. X^{a-} A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, And it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion - a trivalent negative ion group, and a expresses the ionic valence of X, it is an integer of 1-3, m is a dope rate, and the value is 0-0.5. Indole-derivatives trimer shown,

[0016]

[Formula 7]



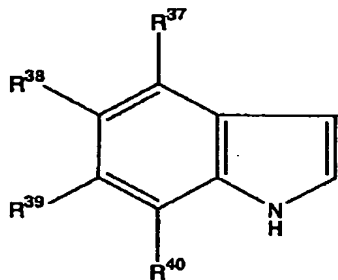
(3) ($R^{25} - R^{36}$ among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2-24 or the carboxylate group of branching, a sulfonic group, The straight chain of the carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, It is shown by the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of $R^{25} - R^{36}$ is a sulfonic group or a carboxyl group. X^{a-} A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, And it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion - a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1-3, m is a dope rate, and the value is 0-0.5. The indole-derivatives trimer etc. which are shown are mentioned.

[0017]The carboxyl group substituted indole trimers among these indole-derivatives trimers. Sulfonic group substituted indole trimers and cyano group substituted indole trimers. Nitro group substituted indole trimers and amide group substituted indole trimers. A trimer in which halogen group substituted indole trimers are preferred practically, and they have acidic groups, such as carboxyl group substituted indole trimers and sulfonic group substituted indole trimers, Since water can be used as a solvent for water solubility, it can use preferably especially also from a field of safety to a human body and environment.

[0018]An indole-derivatives trimer (A) obtained by various synthetic methods, such as chemical composition and electrochemical composition, can be used for an indole-derivatives trimer (A) used by this invention.

[0019]Especially at this invention, it is a following general formula (4).

[Formula 8]



(4) ($R^{37} - R^{40}$ among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2-24 or the carboxylate group of branching, a sulfonic group, The straight chain of the carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, It is the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively. At least a kind of indole derivatives shown, The indole-derivatives trimer (A) obtained by making it react at least into a kind of oxidizer and the reaction mixture which contains a kind of solvent at least is used preferably.

[0020]Indole derivatives shown by a general formula (4) used with a synthetic method of the aforementioned indole-derivatives trimer (A), Specifically 4 **MECHIRU Indore, 5 **MECHIRU Indore, 6 **MECHIRU Indore, 7 **MECHIRU Indore, 4 **ECHIRU Indore, 5 **ECHIRU Indore, 6 **ECHIRU Indore, 7 **ECHIRU Indore, 4-n-propyl Indore, 5-n-propyl Indore, 6-n-propyl Indore, 7-n-propyl Indore, 4-iso-propyl Indore, 5-iso-propyl Indore, 6-iso-propyl Indore, 7-iso-propyl Indore, A 4-n-butyldindole, a 5-n-butyldindole, a 6-n-butyldindole, A 7-n-butyldindole, a 4-sec-butyldindole, a 5-sec-butyldindole, A 6-sec-butyldindole, a 7-sec-butyldindole, a 4-t-butyldindole, Alkyl group substituted indole, such as a 5-t-butyldindole, a 6-t-butyldindole, and a 7-t-butyldindole, 4 **METOKISHI Indore, 5 **METOKISHI Indore, 6 **METOKISHI Indore, 7 **METOKISHI Indore, 4 **ETOKISHI Indore, 5 **ETOKISHI Indore, 6 **ETOKISHI Indore, 7 **ETOKISHI Indore, 4-n-propoxy Indore, 5-n-propoxy Indore, 6-n-propoxy Indore, 7-n-propoxy Indore, 4-iso-propoxy Indore, 5-iso-propoxy Indore, 6-iso-propoxy Indore, 7-iso-propoxy Indore, 4-n-butoxy Indore, 5-n-butoxy Indore, 6-n-butoxy Indore, 7-n-butoxy Indore, 4-sec-butoxy Indore, 5-sec-butoxy Indore, 6-sec-butoxy Indore, 7-sec-butoxy Indore, 4-t-butoxy Indore, 5-t-butoxy Indore, 6-t-butoxy Indore, Alkoxy group substituted indole, such as 7-t-butoxy Indore. Acyl group substituted indole, such as 4 **ASE chill indole, 5 **ASE chill indole, 6 **ASE chill indole, and 7 **ASE chill indole, Indore 4 **KARUBARUDEHIDO, Indore 5 **KARUBARUDEHIDO, Indore 6 **KARUBARUDEHIDO, Aldehyde group substituted indole, such as Indore 7 **KARUBARUDEHIDO. Indore 4 **KARUBON acid, Indore 5 **KARUBON acid, Indore 6 **KARUBON acid, Carboxyl group substituted indole, such as Indore 7 **KARUBON acid. Indore 4 **KARUBON acid methyl, Indore 5 **KARUBON acid methyl, Carboxylate group substituted indole, such as Indore 6 **KARUBON acid methyl and Indore 7 **KARUBON acid methyl. Indore 4 **SURUHON acid, Indore 5 **SURUHON acid, Indore 6 **SURUHON acid, Sulfonic group substituted indole, such as Indore 7 **SURUHON acid. Indore 4 **SURUHON acid methyl, Indore 5 **SURUHON acid methyl, Sulfonic ester group substituted indole, such as Indore 6 **SURUHON acid methyl and Indore 7 **SURUHON acid methyl. Cyano group substituted indole, such as Indore 4 **KARUBO nitril, Indore 5 **KARUBO nitril, Indore 6 **KARUBO nitril, and Indore 7 **KARUBO nitril, 4 **HIDOROKISHI Indore, 5

****HIDOROKISHI** Indore, 6 ****HIDOROKISHI** Indore, Hydroxy group substituted indole, such as 7 ****HIDOROKISHI** indole, 4 ****NITORO** Indore, Nitro group substituted indole, such as 5 ****NITORO** Indore, 6 ****NITORO** Indore, and 7 ****NITORO** Indore. 4 ****AMINO** Indore, 5 ****AMINO** Indore, 6 ****AMINO** Indore, Amino group substituted indole, such as 7 ****AMINO** Indore, 4 ****AMIDO** Indore, Amide group substituted indole, such as 5 ****AMIDO** Indore, 6 ****AMIDO** Indore, and 7 ****AMIDO** Indore. 4 ****FURUORO** Indore, 5 ****FURUORO** Indore, 6 ****FURUORO** Indore, 7 ****FURUORO** Indore, 4 ****KURORO** Indore, 5 ****KURORO** Indore, 6 ****KURORO** Indore, 7 ****KURORO** Indore, 4 ****BUROMO** Indore, Halogen group substituted indole, such as 5 ****BUROMO** Indore, 6 ****BUROMO** Indore, 7 ****BUROMO** Indore, 4 ****YODO** Indore, 5 ****YODO** Indore, 6 ****YODO** Indore, and 7 ****YODO** Indore, can be mentioned.

[0021] In this, carboxyl group substituted indole and sulfonic group substituted indole. Cyano group substituted indole, nitro group substituted indole, amide group substituted indole, and halogen group substituted indole are preferred practically, and carboxyl group substituted indole and especially sulfonic group substituted indole are preferred.

[0022] An oxidizer used with a synthetic method of the aforementioned indole-derivatives trimer (A), Although not limited in particular, for example Ferric chloride 6 hydrate, the anhydrous salt-ized second iron, Second iron of nitric acid 9 hydrate, a ferric sulfate n hydrate, ferric-ammonium-sulfate 12 hydrate, A second iron [of perchloric acid] n hydrate, the second iron of tetrafluoroboric acid, a cupric chloride, The second copper of nitric acid, cupric sulfate, the second copper of tetrafluoroboric acid, nitroso tetrafluoroborate NIUMU, hydrogen peroxide, ammonium persulfate, sodium persulfate, potassium persulfate, potassium periodate, etc. can be mentioned. In this, ferric chloride 6 hydrate, the anhydrous salt-ized second iron, a cupric chloride, the second copper of tetrafluoroboric acid, and ammonium persulfate are preferred practically, and ferric chloride 6 hydrate, and the anhydrous salt-ized second iron are preferred most practically also in it. These oxidizers may be used independently, respectively, or may use together and use two or more sorts at an arbitrary rate.

[0023] a mole ratio of indole derivatives used with a synthetic method of the aforementioned indole-derivatives trimer (A), and an oxidizer — indole-derivatives:oxidizer = 1:0.5 – 100 — it is preferably used by 1:1–50. Here, if a rate of an oxidizer is low, reactivity falls, a raw material remains, a trimer generated when the rate was not much high conversely is peroxidated, and degradation of output may be caused.

[0024] Water and an organic solvent can be used for a solvent used with a synthetic method of the aforementioned indole-derivatives trimer (A). Although an organic solvent in particular is not limited, methanol, ethanol, isopropanol, Acetone, acetonitrile, propionitrile, a tetrahydrofuran, 1,4-dioxane, methyl isobutyl ketone, methyl ethyl ketone, gamma ****BUCHIRU** lactone, propylene carbonate, sulfolane, nitromethane, N,N-dimethylformamide, N-methylacetamide, dimethyl sulfoxide, a dimethylsulfone, N-methyl pyrrolidone, benzene, toluene, xylene, a methylene chloride, chloroform, a dichloroethane, etc. are used. These solvents may be used independently, respectively, or may mix and use two or more sorts at an arbitrary rate. In these solvents, acetone, acetonitrile, 1,4-dioxane, gamma-butyllactone, N,N-dimethylformamide, etc. are preferred, and especially acetonitrile is the most preferred practically.

[0025] Especially a thing you make water and an organic solvent live together, and is made they to react in a synthetic method of the aforementioned indole-derivatives trimer (A) is preferred. a use mole ratio of said

indole derivatives and water — indole-derivatives:water = 1:1000–1000:1 — it is preferably used by 1:100 to 100:1. However, when an oxidizer has crystal water, the amount of crystal water is also measured as water. Here, if a rate of water is low, while a reaction will run recklessly, a trimer will be peroxidated and structure degradation will be carried out, X^{a-} which becomes a dopant to a trimer may be unable to dope efficiently, and conductivity may fall. Conversely, when the rate is too high, advance of oxidation reaction may be barred and a reaction yield may fall.

[0026]in a synthetic method of the aforementioned indole-derivatives trimer (A), concentration of indole derivatives of reaction time receives a solvent — more than 0.01 mass % — desirable — 0.1 – 50 mass % — it is the range of 1 – 30 mass % more preferably.

[0027] X^{a-} in general formula (1) indole-derivatives trimer (A) which is used by this invention and which is shown by – (3) is a dopant, and is the negative ion of proton acid originating in an oxidizer under polymerization, etc. Specifically A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, It is 1 – trivalent negative ion, such as p-toluenesulfonic-acid ion, trifluoro acetate ion, and trifluoromethanesulfonic acid ion, and they are 1 – divalent negative ion, such as a chloride ion, sulfate ion, and the Howe fluoridation ion, preferably. Univalent negative ion of a chloride ion etc. is the most preferred. For example, when it polymerizes by choosing the anhydrous salt-ized second iron as an oxidizer, dopant X^{a-} in an indole-derivatives trimer becomes a chloride ion, and when it polymerizes using trifluoro cupric acetate, dopant X^{a-} becomes trifluoro acetate ion.

[0028]An indole-derivatives trimer (A) obtained with a synthetic method of the aforementioned indole-derivatives trimer (A), Except when using hydrogen peroxide and ozone as an oxidizer, it is a doped type indole-derivatives trimer (A), and mole-ratio (dope rate) m of dopant X^{a-} to the repeating unit is 0.001–0.5. It will be set to $m=0$ if hydrogen peroxide or ozone is used as an oxidizer.

[0029]What carried out dedope processing in order to improve solubility to a solvent (B) more can be used for an indole-derivatives trimer (A). Although not limited especially as a disposal method of a dedope, a method publicly known as a dedope process of various conductive polymers and an electron donor acceptor complex is used, for example from the former. Namely, a method of making an indole-derivatives trimer (A) suspended and removing dopant X^{a-} in alkaline solutions, such as an ammonia solution, sodium hydroxide, a potassium hydrate, and lithium hydroxide, Or a method of obtaining a dedope type indole-derivatives trimer (namely, dope rate $m=0$) by reduction processing is mentioned.

[0030]An indole-derivatives trimer (A) may be more excellent in conducting performance by having a laminated structure. It is preferred to have especially a laminated structure which is 0.1–0.6 nm of interlayer spacings. Such a compound that overly has a detailed laminated structure has good physical properties, such as rigidity, intensity, and heat resistance. However, it is in a tendency for an interlayer spacing to become more stable [a laminated structure] at 0.1 nm or more, and electronic hopping conduction between trimers becomes easier at 0.6 nm or less, and there is a tendency for conductivity to improve.

[0031]Especially if an indole-derivatives trimer (A), a basic compound (C), a high molecular compound (D), a surface-active agent (E), and mineral salt (F) are dissolved or distributed as a solvent (B) which constitutes a conductive composition of this invention, it will not be limited, but water and an organic solvent are used. As an organic solvent, alcohols, such as methanol, ethanol, propanol, and isopropanol, Ketone, such as

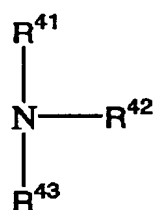
acetone and methyl isobutyl ketone, isopropyl ether, Ether, such as methyl t **BUCHIRU ether, methyl cellosolve, Cellosolves, such as ethylcellosolve, methylpropylene glycol, Pyrrolidones, such as amide, such as propylene glycols, such as ethylpropylene glycol, dimethylformamide, and dimethylacetamide, N-methyl pyrrolidone, and N-ethylpyrrolidone, are used preferably. Water, methanol, isopropanol, acetone, dimethylformamide, dimethylacetamide, and N-methyl pyrrolidone are more preferred especially in respect of [to an indole-derivatives trimer] solubility. These solvents may be used independently, respectively, or at an arbitrary rate, it may mix and they may be used.

[0032]A using rate of an indole-derivatives trimer (A) is 0.1 – 10 mass part preferably 0.01 to 20 mass part to solvent (B) 100 mass part. In 20 or less mass parts, solubility is good and rate of conductivity of an indole-derivatives trimer (A) improves more.

[0033]By adding in a conductive composition, a basic compound (C) which constitutes a conductive composition of this invention dedopes an indole-derivatives trimer (A), and is effective in raising solubility to a solvent (B) more. In a case of carboxyl group substituted indole trimers and sulfonic group substituted indole trimers, solubility to water improves specially by forming a sulfonic group and a carboxyl group, and a salt. Especially as a basic compound (C), although not limited, amines and ammonium salt are used preferably, for example.

[0034]A structural formula of amines used as a basic compound (C) is shown in a lower type.

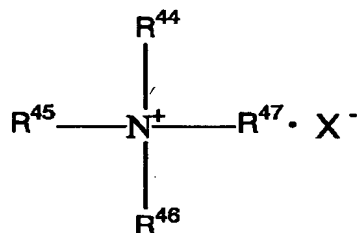
[Formula 9]



(5) $R^{41} - R^{43}$ express hydrogen, the alkyl group of the carbon numbers 1-4 ($C_1 - C_4$), $CH_2 OH$, $CH_2CH_2 OH$, $CONH_2$, or NH_2 mutually-independent respectively among a formula.

[0035]The structural formula of ammonium salt used as a basic compound (C) is shown in a lower type.

[Formula 10]



Respectively $R^{44} - R^{47}$ mutually-independent among a formula (6) Hydrogen, The alkyl group of the carbon numbers 1-4 ($C_1 - C_4$), $CH_2 OH$, Express $CH_2CH_2 OH$, $CONH_2$, or NH_2 and; $X^- OH^-$, $1/2$ and SO_4^{2-} , and NO_3^- , $1/2CO_3^{2-}$, HCO_3^- , $1/2$ and $(COO)_2^{2-}$, or $R'COO^-$ [— the inside of a formula, and $R - ' -$] which is an alkyl group of the carbon numbers 1-3 ($C_1 - C_3$) is expressed.

[0036]A basic compound (C) may mix two or more sorts, and may be used. For example, conductivity can be further raised by mixing and using amines and ammonium salt. Specifically $NH_3/(NH_4)_2CO_3$, $NH_3/(NH_4)HCO_3$ and NH_3/CH_3COONH_4 , $NH_3/(NH_4)_2SO_4$, $N(CH_3)_3/CH_3COONH_4$, $N(CH_3)_3/(NH_4)_2SO_4$, etc. are mentioned.

Although these mixture ratio can be used at an arbitrary rate, $=$ [amines/ammonium salt] $1 / 10 - 10/0$ are

preferred.

[0037]A using rate of a basic compound (C) is 0.1 – 5 mass part preferably 0.1 to 10 mass part to solvent (B) 100 mass part. When a rate of a basic compound (C) is ten or less mass parts, solubility is good and excelling in conductivity etc. is preferred.

[0038]A high molecular compound (D) which constitutes said conductive composition and a conductor of this invention will not be limited especially if a thing to dissolve in a solvent (B) or an emulsion is formed. For example, polyvinyl alcohol, such as polyvinyl alcohol, a polyvinyl formal, and a polyvinyl butyral. Poly acrylamide, poly (N-t-butyl acrylamide), Poly acrylamide, such as poly acrylamide methylpropanesulfonic acid. Polyvinyl pyrrolidones, alkyd resin, melamine resin, urea resin, Phenol resin, an epoxy resin, a polybutadiene resin, an acrylic resin, Urethane resin, vinyl ester resin, a urea resin, polyimide resin, Maleic acid resin, polycarbonate resin, vinyl acetate resin, chlorinated polyethylene resin, Chlorinated polypropylene resin, an acrylic / styrene copolymerization resin, vinyl acetate / acrylic copolymerization resin, polyester resin, styrene / maleic acid copolymerization resin, fluoro-resins, these copolymers, etc. are used. These high molecular compounds (D) may mix two or more sorts at an arbitrary rate.

[0039]A using rate of a high molecular compound (D) is 0.1 – 400 mass part to solvent (B) 100 mass part, and is 0.5 – 300 mass part preferably. In 0.1 or more mass parts, membrane formation nature, a moldability, and intensity improve more, when it is 400 or less mass parts on the other hand, there are few falls of the solubility of an indole-derivatives trimer (A), and high conductivity is maintained.

[0040]Although only the ingredient of an indole-derivatives trimer (A), a solvent (B), a basic compound (C), and a high molecular compound (D) can form a powerful film, if a surface-active agent (E) is added, surface smoothness, spreading nature, conductivity of a conductive composition of this invention, etc. will improve further. A surface-active agent (E) which are a conductive composition of this invention, and an ingredient of a conductor, Alkyl sulfonic acid, alkylbenzene sulfonic acid, alkyl carboxylic acid, Alkyl naphthalene sulfonic acid, alpha olefin sulfonic acid, dialkyl sulfosuccinic acid, alpha-sulfonation fatty acid, N-methyl-N-oleyltaurine, petroleum sulfonic acid, Alkyl sulfuric acid, sulfated oil fat, polyoxyethylene-alkyl-ether sulfuric acid, Polyoxyethylene styrene-ized phenyl ether sulfuric acid, alkyl phosphoric acid, Polyoxyethylene-alkyl-ether phosphoric acid, polyoxyethylene-alkyl-phenyl-ether phosphoric acid, Anionic system surface-active agents, such as naphthalene sulfonic acidformaldehyde condensates and these salts, The first – the third fatty amine, quaternary ammonium, tetra alkylammonium, A urea condensate of trialkyl benzylammonium alkyl pyridinium, 2-alkyl 1-alkyl 1-hydroxyethyl imidazolinium, N,N-dialkyl mol HORINIUMU, polyethylene polyamine fatty acid amide, and polyethylene polyamine fatty acid amide, Cation system surface-active agents, such as quaternary ammonium of a urea condensate of polyethylene polyamine fatty acid amide, and these salts, N,N-dimethyl- N-alkyl N-carboxymethyl ammonium betaine, N,N,N-trialkyl N-sulfo alkylene ammonium betaine, The N and N-dialkyl N, N-bispolyoxyethylene ammonium sulfate ester betaine, Betaines, such as 2-alkyl 1-carboxymethyl 1-hydroxyethyl imidazolinium betaine. Ampholytic surface active agents, such as aminocarboxylic acid, such as N,N-dialkylamino alkylene carboxylate, Polyoxyethylene alkyl ether, polyoxyethylene alkyl phenyl ether, Polyoxyethylene poly styryl phenyl ether, polyoxyethylene polyoxypropylene glycol, Polyoxyethylene polyoxypropylene alkyl ether, polyhydric alcohol fatty acid part ester, Polyoxyethylene polyhydric alcohol fatty acid part ester, polyoxyethylene fatty acid ester, polyglyceryl fatty acid ester, polyoxyethylene-ized

castor oil, fatty acid diethanolamide, Polyoxyethylene alkylamine, triethanolamine fatty acid part ester, Fluorochemical surfactants, such as non-ion system surface-active agents, such as trialkyl amine oxide, and fluoro alkyl carboxylic acid, perfluoroalkyl carboxylic acid, perfluoroalkyl benzenesulfonic acid, and perfluoroalkyl polyoxyethyleneethanol, are used. Here, the carbon numbers 1–24 of an alkyl group are preferred, and its carbon numbers 3–18 are more preferred. Even if it uses two or more sorts of surface-active agents, they do not interfere at all.

[0041]A using rate of a surface-active agent (E) is 0.1 – 5 mass part preferably 0.1 to 10 mass part to solvent (B) 100 mass part.

[0042]If mineral salt (F) is added further, solubility of a conductive composition of this invention of an indole-derivatives trimer (A) to a solvent (B) will improve. Although mineral salt (F) in particular is not limited, alkali metal salt, alkaline earth metal salt, etc. are used preferably. For example, a lithium chloride, a lithium bromide, lithium iodide, lithium hydroxide, lithium carbonate, a lithium nitrate, oxalic acid lithium, lithium phosphate, and lithium sulfate are used preferably. Even if it uses two or more sorts of mineral salt, it does not interfere at all.

[0043]A using rate of mineral salt (F) is 0.1 – 3 weight section preferably 0.1 to 5 weight section to solvent (B) 100 weight section.

[0044]In a conductive composition furthermore used for this invention, preservation stabilizer, a bonding assistant, a cross linking agent, etc. can be added if needed.

[0045]A conductive composition by this invention is under a room temperature, or carries out heating stirring of an indole-derivatives trimer (A), a solvent (B), a basic compound (C), a surface-active agent (E), and the mineral salt (F), dissolves thoroughly, or it mixes and it is prepared. A conductor of this invention can be formed by applying to a substrate a conductive composition prepared as mentioned above.

[0046]Although a conductor of this invention has the conductivity excellent also in as [this], After applying a conductive composition and forming a transparent conductive film on at least one field of a substrate, conductivity can be further raised by acid's performing doping processing and subsequently carrying out neglect or heat-treatment at ordinary temperature.

[0047]Although it is not limited in particular for a doping disposal method by acid and a publicly known method can be used, doping processing can be performed by processing making a conductor immersed into an acidic solution etc. for example. An acidic solution specifically Inorganic acid, such as chloride, sulfuric acid, and nitric acid, and p-toluenesulfonic acid, Organic acid, such as a derivative which has camphor sulfonic acid, benzoic acid, and these skeletons, They are solution containing polymer acid, such as a derivative which has polystyrene sulfonate, polyvinyl sulfonic acid, poly(2-acrylamide isobutane) sulfonic acid, polyvinyl sulphates, and these skeletons, or a mixed solution of a water-organic solvent. These inorganic acid, organic acid, and polymer acid may be used independently, respectively, or may mix and use two or more sorts at an arbitrary rate.

[0048]A conductive composition is processible on the surface of a substrate by a method used for a general paint as a formation method of a conductor of this invention. For example, a photogravure coating machine, a roll coater, a curtain flow coater, A spin coater, a bar coating machine, a reverse coating machine, a kis coating machine, Dip coating, such as atomizing processes, such as the applying methods, such as a fan ten coating machine, a rod coating machine, an exhaust air doctor coating machine, a knife coating machine, a

braid coating machine, cast coating, and screen coating, and spray coating, and dip, etc. are used.

[0049]Although a transparent conductive film formed with a conductive composition can be formed to 0.01–1000 micrometers of thickness, Since there is a tendency for the transparency of a transparent conductive film to fall when thickness is large, a thing thin if possible is usually preferred, and it is preferably good the range of 0.01–500 micrometers, and to consider it as the range of 0.02–100 micrometers still more preferably. In order to obtain a transparent conductive film of the above-mentioned thickness, it is preferred to make viscosity of a conductive composition into the range of 1 – 500cp preferably, and to make it into the range of 0.1 to 80 % of the weight of the amounts of solid content 1000 or less cp.

[0050]As a substrate which carries out coating of the conductive composition, a high molecular compound, wood, a paper material, ceramics and its film, or a glass plate is used. As a high molecular compound and a film, for example, polyethylene, polyvinyl chloride, Polypropylene, polystyrene, polyester, ABS plastics, an AS resin, Methacrylic resin, polybutadiene, polycarbonate, polyarylate, Polyvinylidene fluoride, polyamide, polyimide, polyaramide, a polyphenylene sulfide, A polyether ether ketone, polyphenylene ether, polyether nitril, polyamidoimide, polyether sulphone, Pori Sall John, polyether imide, polybutylene terephthalate, its film, etc. exist. It is preferred a corona surface treatment or to carry out plasma treatment of the above-mentioned film surface in order for these high polymer films to make a transparent conductive poly membrane form in the one field at least, and to raise the adhesion of this poly membrane. After forming a transparent conductive film in a substrate, a conductor whose performance improved is formed by heating by a retained material of a basic compound (C) decreasing, and conductivity's improving, and heat-treating 250 ** or less in 40–200 ** preferably.

[0051]

[Example]An example explains this invention still more concretely below.

[0052]In the example of indole-derivatives trimer composition, ultimate analysis measurement is thermostat Qwest, Inc. make. It measured by EA1110. Conductivity measurement was measured by Mitsubishi Chemical Loles Tarr meter MCP-T350 (4 terminal method: 1 mm of inter electrode distance). The X-ray diffraction analysis (XRD) was measured by RINT-1100 (bulb: CuK_{α} X-rays) by Rigaku Corp.

[0053]10 ml of acetonitrile was put into the 3 Thu mouth flask of 200 ml of composition of a synthetic example 1 indole- 5-carboxylic acid trimer, and the indole- 5-carboxylic acid 1.42g was dissolved. On the other hand, to 40 ml of acetonitrile, preparation of an oxidizer solution dissolved the anhydrous salt-ized second iron 16.2g, and the water 5.4g, and stirred them for 10 minutes. Next, after applying to indole- 5-carboxylic acid solution for 30 minutes and dropping the prepared oxidizer solution, it stirred at 60 ** for 10 hours. The reaction solution changed from thin yellow to light green, being accompanied by some generation of heat, and the pH was one or less. Carry out suction filtration by the Kiriya funnel after ending reaction, and it washes and dries with methanol by the acetonitrile following **, Light green 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole 2,9,14-tricarboxylic acid and 1.12 (indole- 5-carboxylic acid trimer) g (79% of yield) were obtained. It was 0.41 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $\text{C}_{9.00}\text{H}_{4.90}\text{N}_{1.09}\text{O}_{1.98}\text{Cl}_{0.11}$. The interlayer spacing was 0.48 nm as a result of X diffraction crystal analysis.

[0054]It polymerized by the same method as the synthetic example 1 except using indole- 6-carboxylic acid instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 2 indole- 6-carboxylic acid trimer. Light green 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole 3,8,13-tricarboxylic acid and 1.16 (indole- 6-carboxylic acid trimer) g (82% of yield) were obtained. It was 0.50 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{9.00}H_{4.93}N_{1.07}O_{1.98}Cl_{0.12})$.

[0055]It polymerized by the same method as the synthetic example 1 except using indole- 5-sulfonic acid instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 3 indole- 5-sulfonic acid trimer. Green 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole 2,9,14-trisulfonic acid and 1.01 (indole- 5-sulfonic acid trimer) g (71% of yield) were obtained. It was 0.56 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{8.00}H_{4.85}N_{1.06}O_{3.01}S_{1.06}Cl_{0.11})$.

[0056]It polymerized by the same method as the synthetic example 1 except using indole- 4-carboxylic acid instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 4 indole- 4-carboxylic acid trimer. Light green 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole 1,10,15-tricarboxylic acid and 1.10 (indole- 4-carboxylic acid trimer) g (77% of yield) were obtained. It was 0.52 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{9.00}H_{4.81}N_{1.02}O_{1.98}Cl_{0.11})$.

[0057]It polymerized by the same method as the synthetic example 1 except using indole- 4-sulfonic acid instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 5 indole- 4-sulfonic acid trimer. Green 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole 2,9,14-trisulfonic acid and 1.01 (indole- 4-sulfonic acid trimer) g (71% of yield) were obtained. It was 0.46 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{8.00}H_{4.95}N_{1.01}O_{3.02}S_{1.00}Cl_{0.15})$.

[0058]It polymerized by the same method as the synthetic example 1 except using 5-fluoro Indore instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 65-fluoro Indore trimer. Blue dark **JIINDORO [2,9,14-trifluoro-6,11-dihydro-5H] [2,3-a:2',3'-c] carbazole and 1.00 (5 **FURUORO Indore trimer) g (70% of yield) were obtained. It was 0.57 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{8.00}H_{4.01}N_{0.99}F_{0.97}Cl_{0.16})$. The interlayer spacing was 0.38 nm as a result of X diffraction crystal analysis.

[0059]It polymerized by the same method as the synthetic example 1 except using indole- 5-carbonitrile instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 7 indole- 5-carbonitrile trimer. Green 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole 2,9,14-TORIKARUBO nitril and 1.22 (indole- 5-carbonitrile trimer) g (86% of yield) were obtained. It was 0.50

S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{9.00}H_{4.03}N_{1.97}Cl_{0.10})$. The interlayer spacing was 0.44 nm as a result of X diffraction crystal analysis.

[0060]It polymerized by the same method as the synthetic example 1 except using 5-amide indole instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 85-amide indole trimer. Blue dark **JIINDORO [2,9,14-Tori Amidou 6,11-dihydro-5H] [2,3-a:2',3'-c] carbazole and 1.07 (5 **AMIDO Indore trimer) g (75% of yield) were obtained. It was 0.59 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{9.00}H_{6.01}N_{2.02}O_{1.97}Cl_{0.15})$.

[0061]It polymerized by the same method as the synthetic example 1 except using 6-nitroindole instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 96-nitroindole trimer. Blue dark **JIINDORO [6,11-dihydro-3,8,13-trinitro 5H] [2,3-a:2',3'-c] carbazole and 1.12 (6 **NITORO Indore trimer) g (79% of yield) were obtained. It was 0.53 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was $_3(C_{8.00}H_{4.00}N_{2.02}O_{1.97}Cl_{0.15})$.

[0062]It was made to distribute in 1M ammonia solution, and 1.00 g of indole- 5-carbonitrile trimers compounded in the example 7 of synthetic composition of the indole- 5-carbonitrile trimer of a synthetic example 10 dedope state were stirred for 1 hour. carrying out suction filtration by the Kiriya funnel after stirring — water — subsequently methanol washed, it dried and 0.95 g of indole- 5-carbonitrile trimers of a black dedope state were obtained. When application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method, it was 0.04 or less S/cm. The result of ultimate analysis was $_3(C_{9.00}H_{4.02}N_{2.02})$.

[0063]It is synthetic aniline 100mmol of poly aniline of a synthetic example 11 dedope state at 25 ** 1 mol/L The stirring dissolution was carried out and the solution of ammonium-peroxodisulfate 100mmol was dropped at sulfuric acid solution. After the end of dropping, and after stirring further at 25 ** for 12 hours, the resultant was dried after [classified by **] washing, and the polymer powder 8g was obtained. When application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method, it was 1.0 or less S/cm. After carrying out distributed stirring of this polymer in 1 mol/L ammonia solution at 25 ** in 1 hour, it dried after [classified by **] washing, and the polymer powder 5g of a dedope state was obtained.

[0064]Composition of synthetic example 12 poly (2-sulfo- 5-methoxy-1,4-imino phenylene) (sulfonation poly aniline)

The stirring dissolution of the 2-aminoanisole 4-sulfonic acid 100mmol was carried out at 25 ** at the aqueous ammonia solution of 4 mol/L, and the solution of ammonium-peroxodisulfate 100mmol was dropped. After the end of dropping, and after stirring further at 25 ** for 12 hours, the resultant was dried after

[classified by **] washing, and the polymer powder 15g was obtained. When application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method, it was 0.11 or less S/cm.

[0065]The 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-c] carbazoles 2 and 9 of the example 1 of the example 1 above-mentioned composition, 14-tricarboxylic acid, (Indole- 5-carboxylic acid trimer) The stirring dissolution of the 0.2 mass part was carried out at the room temperature at dimethylformamide 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 100 **. The water-white film of smooth surface resistance value $6.4 \times 10^8 \Omega$ of the surface of 0.1 micrometer of thickness was obtained.

[0066]The stirring dissolution of example 2 indole- 5-carboxylic acid trimer 5 mass part and the ammonia 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The water-white film of smooth surface resistance value $2.2 \times 10^6 \Omega$ of the surface of 3.5 micrometers of thickness was obtained.

[0067]The stirring dissolution of example 3 indole- 5-carboxylic acid trimer 3 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the ammonia 1.0 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The water-white film of smooth surface resistance value $1.4 \times 10^7 \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0068]The 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-c] carbazoles 3 and 8 of the example 2 of the example 4 above-mentioned composition, 13-tricarboxylic acid, (Indole- 6-carboxylic acid trimer) The stirring dissolution of three mass parts, vinyl emulsion "PEGARU P365" (made by high pressure gas chemicals company) 4 mass part, and the monomethylamine 0.2 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The water-white film of smooth surface resistance value $6.0 \times 10^7 \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0069]The 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-c] carbazoles 2 and 9 of the example 3 of the example 5 above-mentioned composition, 14-trisulfonic acid, (Indole- 5-sulfonic acid trimer) The stirring dissolution of three mass parts, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the ammonia 0.4 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The water-white film of smooth surface resistance value $2.9 \times 10^7 \Omega$ of the surface of 2.0 micrometers of thickness was obtained.

[0070]The 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-c] carbazoles 1 and 10 of the example 4 of the example 6 above-mentioned composition, 15-tricarboxylic acid, (Indole- 4-carboxylic acid trimer) The stirring dissolution of three mass parts, dodecylbenzenesulfonic acid 1 mass part, and the triethylamine 2 mass part was carried out at the room temperature at water 50 mass part and methanol 50 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat

method on the glass substrate, and was dried at 80 °C. The water-white film of smooth surface resistance value $2.2 \times 10^7 \Omega$ of the surface of 2.0 micrometers of thickness was obtained.

[0071]The stirring dissolution of example 7 indole- 5-carboxylic acid trimer 5 mass part, ammonia 2 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the dodecylbenzenesulfonic acid 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 °C. The water-white film of smooth surface resistance value $2.5 \times 10^6 \Omega$ of the surface of 5.0 micrometers of thickness was obtained.

[0072]6,11-dihydro-5H-pyrido[2,3-a:2',3'-]carbazole 1,10,15-trisulfonic acid (indole- 4-sulfonic acid trimer) 3 mass part of the example 5 of the example 8 above-mentioned composition, The stirring dissolution of ammonia 2 mass part, urethane emulsion "ADEKABON titer UX-1845" (made by Asahi electrification company) 4 mass part, and the perfluoro dodecylcarboxylic acid 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied by the bar code method on the PET film, and was dried at 80 °C. The water-white film of smooth surface resistance value $2.8 \times 10^7 \Omega$ of the surface of 2.0 micrometers of thickness was obtained.

[0073]The stirring dissolution of example 9 indole- 5-carboxylic acid trimer 1 mass part, water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 4 mass part, and the dodecylbenzenesulfonic acid 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied by the bar code method on the PET film, and was dried at 80 °C. The water-white film of smooth surface resistance value $5.0 \times 10^7 \Omega$ of the surface of 1.0 micrometer of thickness was obtained.

[0074]The stirring dissolution of example 10 indole- 4-carboxylic acid trimer 1 mass part and the lithium bromide 2 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 °C. The water-white film of smooth surface resistance value $1.0 \times 10^8 \Omega$ of the surface of 1.0 micrometer of thickness was obtained.

[0075]The stirring dissolution of example 11 indole- 6-carboxylic acid trimer 3 mass part, ammonia 2 mass part, and the lithium-chloride 2 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied by the bar code method on the PET film, and was dried at 80 °C. The water-white film of smooth surface resistance value $1.0 \times 10^7 \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0076]The stirring dissolution of example 12 indole- 5-carboxylic acid trimer 0.5 mass part, ammonia 1 mass part, and the water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 3 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 °C. The water-white film of smooth surface resistance value $2.0 \times 10^8 \Omega$ of the surface of 0.5 micrometer of thickness was obtained.

[0077]The stirring dissolution of example 13 indole- 5-carboxylic acid trimer 1 mass part, ammonia 1 mass part, water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 3 mass

part, and the lithium-chloride 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The water-white film of smooth surface resistance value $5.0 \times 10^{-7} \Omega$ of the surface of 1.0 micrometer of thickness was obtained.

[0078] Example 14 indole- 6-carboxylic acid trimer 3 mass part, ammonia 0.5 mass part, The stirring dissolution of urethane emulsion "ADEKABON titer UX-1845" (made by Asahi electrification company) 3 mass part, dodecylbenzenesulfonic acid 1 mass part, and the lithium-chloride 2 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied by the bar code method on the PET film, and was dried at 80 **. The water-white film of smooth surface resistance value $2.5 \times 10^{-7} \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0079] The stirring dissolution of example 15 indole- 5-sulfonic acid trimer 3 mass part, water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 3 mass part, dodecylbenzenesulfonic acid 1 mass part, and the lithium-chloride 2 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The water-white film of smooth surface resistance value $2.5 \times 10^{-7} \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0080] The stirring dissolution of example 16 indole- 5-carboxylic acid trimer 5 mass part, ammonia 3 mass part, dodecylbenzenesulfonic acid 1 mass part, and the lithium-chloride 2 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The water-white film of smooth surface resistance value $2.5 \times 10^{-6} \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0081] 2,9,14-trifluoro-6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole (5-fluoro Indore trimer) 1 mass part of the example 6 of the example 17 above-mentioned composition, The stirring dissolution of polyester resin (Toyobo Byron 290) 4 mass part and the ammonia 0.2 mass part was carried out at the room temperature at isopropanol 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with cast coat method on the glass substrate, and was dried at 70 **. The water-white film of smooth surface resistance value $1.0 \times 10^{-8} \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0082] The 6,11-dihydro-5H **JIINDORO [2,3-a:2',3'-] [c] carbazole 2,9,14-TORIKARUBO nitril of the example 7 of the example 18 above-mentioned composition, (Indole- 5-carbonitrile trimer) The stirring dissolution of one mass part, polyester resin (Toyobo Byron 290) 0.5 mass part, and the ammonia 0.7 mass part was carried out at the room temperature at acetone 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the dip method on the glass substrate, and was dried at 70 **. The water-white film of smooth surface resistance value $3.0 \times 10^{-7} \Omega$ of the surface of 1.0 micrometer of thickness was obtained.

[0083] The stirring dissolution of example 19 5-fluoro Indore trimer 3 mass part and the polyester resin (Toyobo Byron 290) 0.5 mass part was carried out at the room temperature at dimethylformamide 100 mass

part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 100 °C. The water-white film of smooth surface resistance value $2.0 \times 10^{-7} \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0084]The 2,9,14-Triamidou 6,11-dihydro-5H **JIINDORO** [2,3-a:2',3'-c] carbazole of the example 8 of the example 20 above-mentioned composition, (5 **AMIDO** Indore trimer) The stirring dissolution of three mass parts and the dodecylbenzenesulfonic acid 1 mass part was carried out at the room temperature at dimethylformamide 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied by the bar code method on the PET film, and was dried at 100 °C. The water-white film of smooth surface resistance value $2.5 \times 10^{-7} \Omega$ of the surface of 2.0 micrometers of thickness was obtained.

[0085]The stirring dissolution of example 215-cyanoindole trimer 1 mass part, polyester resin (Toyobo Byron 290) 3 mass part, and the lithium-chloride 2 mass part was carried out at the room temperature at methanol 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 70 °C. The water-white film of smooth surface resistance value $5.0 \times 10^{-7} \Omega$ of the surface of 3.0 micrometers of thickness was obtained.

[0086]The 6,11-dihydro-3,8,13-trinitro 5H **JIINDORO** [2,3-a:2',3'-c] carbazole of the example 9 of the example 22 above-mentioned composition, (6 **NITORO** Indore trimer) The stirring dissolution of one mass part, dodecylbenzenesulfonic acid 1 mass part, and the lithium-chloride 2 mass part was carried out at the room temperature at dimethylacetamide 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 100 °C. The water-white film of smooth surface resistance value $5.0 \times 10^{-7} \Omega$ of the surface of 1.0 micrometer of thickness was obtained.

[0087]The stirring dissolution of the indole-5-carbonitrile trimer 8 mass part of a dedope state of the example 10 of the example 23 above-mentioned composition was carried out at the room temperature at dimethylformamide 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 150 °C. After this glass substrate was immersed for 5 minutes into 1M sulfuric acid solution, it was made to dry at 100 °C. The water-white film of smooth surface resistance value $1.1 \times 10^{-6} \Omega$ of the surface of 2.0 micrometers of thickness was obtained.

[0088]Poly aniline 1 mass part of a dedope state of the example 11 of the comparative example 1 above-mentioned composition, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, The stirring dissolution of the perfluoro dodecylcarboxylic acid 1 mass part was carried out at the room temperature at N-methyl-2-pyrrolidone 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 150 °C. 1M sulfuric acid solution was made to immerse this glass substrate for 10 minutes, it was dried at 100 °C, and the dark blue film of smooth surface resistance value $3.0 \times 10^{-9} \Omega$ of the surface of 1.0 micrometer of thickness was obtained.

[0089]The stirring dissolution of comparative example 2 carbon-black 1 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the sodium-polystyrene-sulfonate 1 mass part was carried out at the room temperature at water 100 mass part,

and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The black film of smooth surface resistance value 3.0×10^{-12} ohm of the surface of 1.0 micrometer of thickness was obtained.

[0090]The stirring dissolution of comparative example 3 sodium-polystyrene-sulfonate 1 mass part and the acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The film of smooth surface resistance value 5.0×10^{-13} ohm of the surface of 0.7 micrometer of thickness was obtained.

[0091]Poly (2-sulfo- 5-methoxy-1,4-imino phenylene) (sulfonation poly aniline) 1 mass part of the example 12 of the comparative example 4 above-mentioned composition, The stirring dissolution of ammonia 1 mass part, water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 3 mass part, and the lithium-chloride 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 **. The yellow bright film of smooth surface resistance value 7.5×10^{-7} ohm of the surface of 1.0 micrometer of thickness was obtained.

[0092]

[Effect of the Invention]1. The conductive composition by this invention can obtain the conductive thin film which there is no humidity dependency in a suitable substrate about this constituent only at spreading, a spray, the cast, dip, and heat-treatment, revealed high conductivity, and was excellent in membrane formation nature, a moldability, and water-white nature.

In this invention, an indole-derivatives trimer 2. Membrane formation nature, moldability, About the transparent conductive poly membrane excellent in water-white nature, there is no humidity dependency in a suitable substrate after formation and at ordinary temperature by processing of spreading, a spray, the cast, dip, etc. only at neglect or heat-treatment, high conductivity can be revealed, and a conductor with small dispersion in surface resistance can be obtained.

[Translation done.]